AMATEUR WORK

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ELEMENTARY SHOP PRACTICE.

Frederick W. Turner, Rindge Manual Training School, Cambridge, Mass.

III. FILES AND FILING

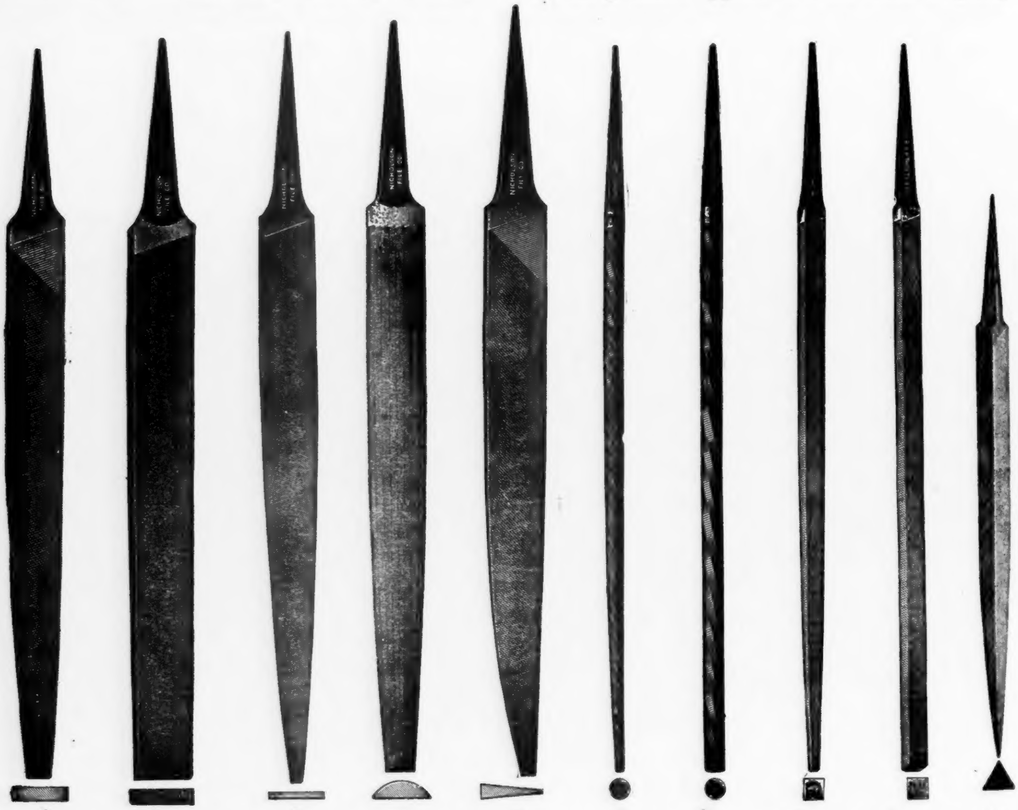
Although the hammer and chisel will do fairly well for smoothing surfaces which do not require definite relations, it is not often that chipped surfaces are not further finished by the use of the file. As a universal tool, and one which the workman has occasion to use very frequently, the file certainly holds the palm. It differs from the chisel in many respects: it presents a large number of cutting points instead of one cutting edge; it is driven or pushed by hand in place of the hammer-blow on the chisel, and it follows from these radical changes, that the metal will not be removed in the same way as by the chisel. In fact, the chips from the file are so fine as to resemble dust, and the amount of metal which can be removed in a given time is greatly in favor of the chisel.

In view of the fact that the file is so universally used, it will be well to consider in a brief way before taking up the various shapes and sizes, the different processes of manufacture. It will not be possible or desirable to follow the manufacture of every tool on the machinist's bench, but the file may be looked upon as typical of all forms of cutting tools, and as its manufacture is somewhat complicated, a description will serve to cover the simpler forms.

Files are made from a good grade of tool steel, and pass through the successive stages of forging, annealing, grinding, stripping, cutting, hardening and tempering, with rigid inspection after each process. The forging and grinding hardly require description. The annealing is for the purpose of softening the blanks in a uniform manner, and the stripping smooths them up just previous to the important operation of cutting. Whether done by hand or machine, the cutting is performed by driving a chisel into the soft steel, raising a sharp edge at such an angle to the axis of the file as to produce a shearing cut. All files with convex surfaces are cut only in one direction, as is also the case with the so-called single cut files of rectangular section. More commonly, however, a second cut is made nearly at right angles to the first, thus raising a multitude of cutting points. The hardening is usually done by heating in a pot of red-hot lead, thus securing a uniform temperature, and then quenching in water, after which they are tempered by reheating in an oil that is maintained at the heat necessary to give the temper required.

Files have three distinguishing features: length, kind, and cut or grade of coarseness. The length is measured from the heel to the point, and does not include the tang or part to be imbedded in the handle. For coarse, heavy work, files 12″ and sometimes 14″ long are used, while the lengths for finishing vary from 4″ to 10″. The kind of file is usually specified by its shape or use, although, in some cases, the names appear to be mere arbitrary terms. Referring to the cuts shown, the round, square, half round, and three square clearly indicate shape, while the crossing, warding, and tumbler are indicative of the use of the file. The cut of files is divided between the character and the coarseness of the teeth. The two kinds of teeth commonly used are single cut and the double cut, and refer to the method of

cutting already mentioned. The relative coarseness of the teeth is well shown in the several small sections, illustrated in Fig. 22. There is a coarser tooth than any shown, called coarse, and a finer one called dead smooth. The bastard, second cut and smooth are the grades in common use. In naming a file, three features must be specified. For example, a file much used for snagging and coarse work is the 12″ flat bastard, while finishing may be done with an 8″ hand smooth. It is not customary to call for a double cut file, as nearly all files are double cut. The mill file, however, is always single cut and is used for draw-filing and for filing work which is rotated in a lathe. This file is sometimes called a float file, and a 10″ mill or float smooth is the size usually employed. The amateur is apt to confuse the terms double cut and second cut. It should be remembered that the first refers to a kind of tooth and the second to a grade of coarseness. The coarseness of the tooth varies in the same kind of cut according to the length of the file. For example, a 12″ bastard in any shape has a coarser tooth than an 8″ bastard, and the same is true of every cut and length.



1 2 3 4 5 6 7 8 9 10

1, Flat File. 2, Hand File. 3, Warding File. 4, Half-Round File. 5, Knife File. 6, Round Taper File. 7, Round Blunt File. 8, Square Taper File. 9, Square Blunt File. 10, Three-Square File.

FIG. 21. SOME OF THE DIFFERENT SHAPES OF FILES.

As the pressure applied to a file tends to spring it out of shape it is evident that a file with a perfectly flat face would produce a rounded surface. To avoid this tendency, files are made slightly convex in the direction of their length, this convexity being commonly called the belly of the file. Hand files have more belly than flat files, and are nearly parallel in width throughout their length, while flat files are much narrower at the point than at the middle of the file.

As a good file with a poor handle, or badly set

in a good handle, is of little value, a few words regarding handles will not be amiss. Hard wood, such as apple or cherry, makes the best handles, but soft wood handles, if properly shaped and ferruled, are very satisfactory. A hole should be drilled for the tang, care being taken to drill in the axis of the handle. If the tang is driven in, the handle has, in spite of the ferrule, a tendency to split. The tang of an old file may be heated to a dull red and the handle burned out to the desired depth. A slight tap will then secure the file without danger of breaking the handle. If the tang of a new file is heated, a piece of wet waste may be wrapped around the file proper to avoid drawing its temper. The axis of the file and handle should form a straight line.

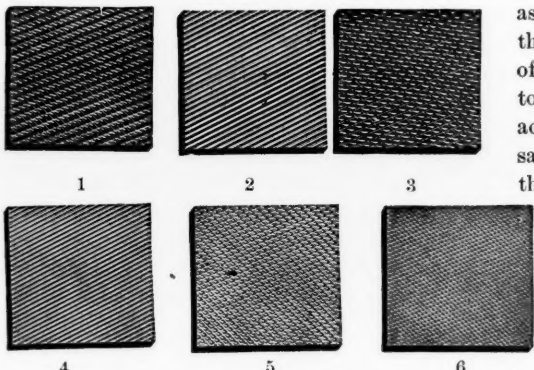


FIG. 22. CUTS OF 12-INCH FILES

1, Double Cut Coarse. 2, Single Cut Coarse. 3, Double Cut Bastard. 4, Single Cut Bastard. 5, Double Cut 2d Cut. 6, Double Cut Smooth.

To use the file to the best advantage, the character of the work and the size of the workman should be considered. Ordinarily the work is held in the vise with the portion to be filed at the height of the workman's elbow. This allows the file to be carried across the work by movement of the shoulder and elbow joints, keeping the forearm, wrist, hand and file as nearly rigid as possible. For rough, heavy work, the vise should be placed somewhat lower so the weight of the body may be brought to bear on the file, while light, delicate filing should be done in a vise considerably higher than above, because such work depends more on good light and good judgement than on the power applied.

The workman should stand with his feet nearly at right angles, 10″ or 12″ apart, the left foot

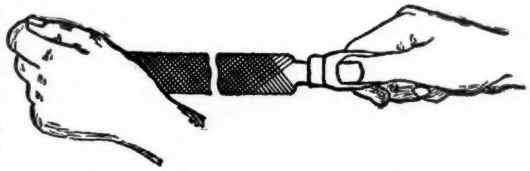


FIG. 23. POSITION FOR HEAVY FILING.

pointing in the direction of the file. He should also be far enough back so that the body may swing up toward the vise a trifle with each stroke of the file. The end of the handle should rest against the fleshy part of the right hand below the little finger, the thumb extending along the *top* and all the fingers curled *under* the handle, as shown in Fig. 23. The position of the hand is thus carefully stated on account of the tendency of the beginner to place the forefinger along the top of the handle, which not only impairs the accuracy of the work, but also causes an unnecessary amount of fatigue. The ball of the thumb of the left hand is placed on the point of the file when pressure is demanded, but when doing light accurate work, the point is grasped between the thumb and the first two fingers.

As the teeth point toward the end of the file, metal can be removed only during the forward stroke, and in order to avoid breaking the teeth the pressure should be relieved during the backward stroke. The file should not be removed from the work during

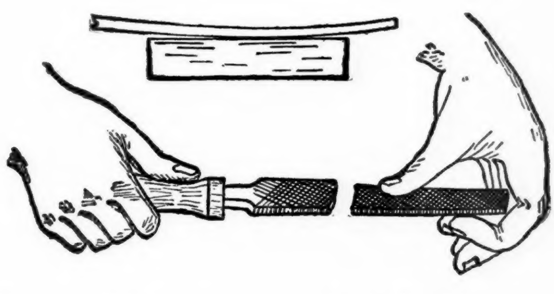


FIG. 24. POSITION FOR LIGHT FILING.

the back stroke, as we would thereby lose the guiding effect of the surface.

The above method of filing applies when there

is much metal to be removed, but when simply straightening out the marks preparatory to polishing, it is much better and easier to grasp the file with both hands and move it crosswise along the work, as shown in Fig. 25. This is called draw-filing, and in addition to its value as a preparation for polishing, it is used to change the direction of the tool marks left by turning. For example, draw-filing the end of a shaft before forcing on a coupling, or draw-filing a piston rod to avoid cutting the packing. Single cut files are better than double cut for this purpose, being less liable to scratch the work.

Although files are comparatively cheap, careless use of them will run up a bill which will astonish the man who pays it.

Some hints as to selection and use may prove of

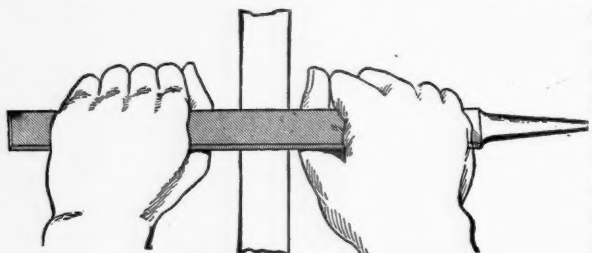


Fig. 25. Position for Draw-filing.

value to our readers. New files should be started in on brass composition, etc., then used on clean surfaces in steel and iron, then on forged work and steel castings, and last of all for snagging and cleaning brazed joints. A new file may be ruined by a few strokes over a piece of tool or a chilled casting. The reason for this is that the long sharp teeth of a new file may be broken out bodily by such usage, but a slightly worn file cannot be made to bite

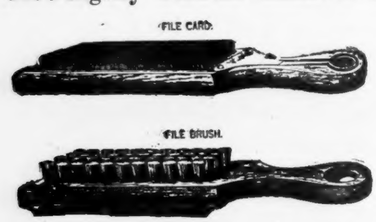


Fig. 26. File Card and Brush.

deep enough to break the teeth. It is also found that it is not advisable to use a coarser file on tool steel than the second cut. Old files which will not touch tool steel, do very satisfactory work in smoothing up brazed joints. The glassy surface left by the flux when brazing is especially hard on a new file, or in fact, any kind of a file. Filing with slow, steady, powerful strokes will accomplish more with less fatigue than with light quick strokes, and the file will also be kept in better

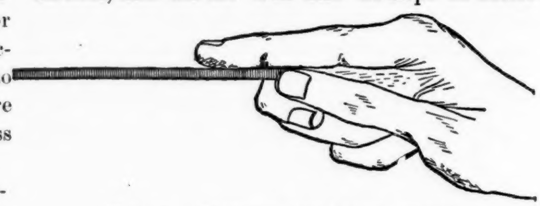


Fig. 27. Position for Light Filing.

condition. Always use the coarsest file possible, consistent with the surface desired. Do not use files which have become clogged with filings, or which have caught long particles of metal, called *pins*. A file brush or card should be kept close at hand, and if this fails to remove the pins, pick them out with a scriber. Pins scratch the surface badly and prevent rapid work. Chalk or oil, especially on a new file, will make it cut finer and to a large degree, prevent clogging. Cast iron, however, must always be worked dry. The surface should not even be rubbed with the fingers, as this will leave a film of grease which causes the file to slip. When filing cast iron the chips can be removed by striking the edge of the file on the bench or vise. Do not keep files in a pile on the bench or thrown carelessly into a drawer. This will damage them more than a large amount of legitimate use. Keep them in a rack, or so arranged in the drawer that they will not touch one another.

Fig. 28. Position for Filing Holes.

Do not forget to look over the Premium List in this number. There are some fine tools in it that you will want in your outfit.

WOOD TURNING FOR AMATEURS

F. W. Putnam, Instructor Manual Training School, Lowell, Mass.

VI. COMPOUND CURVES

For this exercise we will require a pine block 3"x3" by 8½" in length.

First turn the block down to the required diameter 2¾", and mark off the necessary dimensions as shown in Fig. 51. Both the convex and concave curves are to be half circles in outline, the concave curves being cut first, in the divisions marked *a*, Fig. 51. The stock between the division lines is to be removed by a series of cuts as shown in Figs. 52 to 58.

Before starting to cut these curves, make sure that the ½" gouge is thoroughly sharp, and that the cutting edge is a smooth elliptical curve without nicks or high places. When the cut is first started the tee rest should be fastened quite a little above the centre. As the cutting of the curve progresses, it may be found advisable to change its position. Beyond saying that the tee rest should always be at least a little above the centre of the work, no rule can be given as to the exact height at which to place the rest. The position taken should be that which seems to be the most convenient.

Fig. 52 shows the position of the gouge for the first cut. The cutting edge is held square across the work, a little distance inside the division line of the curve. This is necessary, for the gouge, if started at an angle with the work, would be very likely to run off to one side or the other and so cut outside the division lines. The gouge is to be forced in for a short distance, and the handle slightly turned by the right wrist, after which the tool is to be withdrawn and the operation repeated on the left side as shown in Fig. 53. The gouge is now to be forced a little deeper into the wood as shown in Fig. 54, and the handle turned until the gouge is gradually turned over on its back during the cut as shown in Fig. 55, until it reaches the position shown in Fig. 56. Start a second cut on the right hand side, the cutting edge now being placed a little nearer the division line. This position is shown in Fig. 57. It will be noticed that, for this, and for the final cuts, the under bevel of the gouge is very nearly at right angles with the axis of rotation, while the shaft of the gouge is no longer at right angles to the axis of the work.

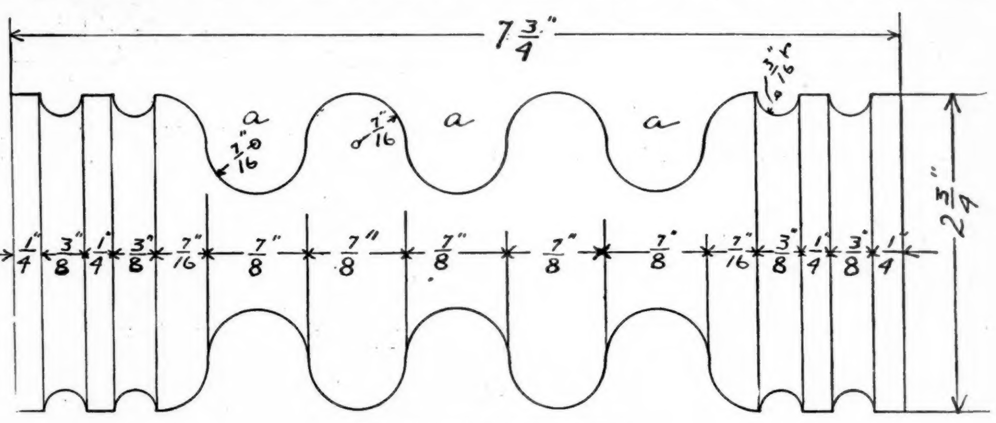


Fig. 51. Compound Curves

Next finish this cut from the left side, holding the gouge with the bevel in the position just described. Final cuts are to be taken in the position as shown in Fig. 58, when the final cut should give the exact depth and shape to the curve. It

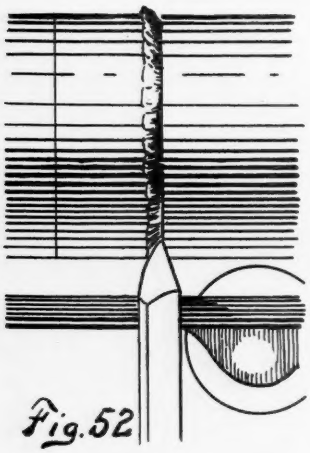


Fig. 52

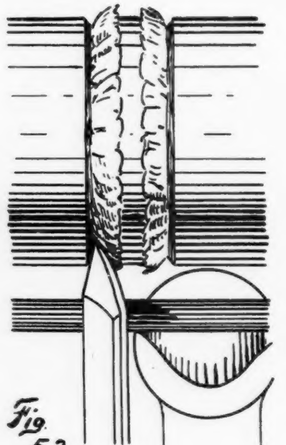


Fig. 53

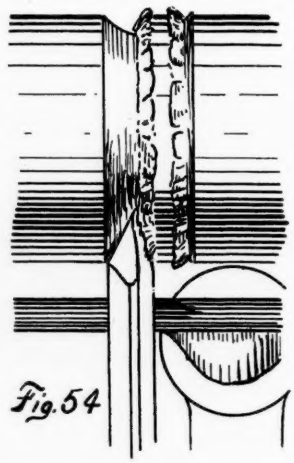


Fig. 54

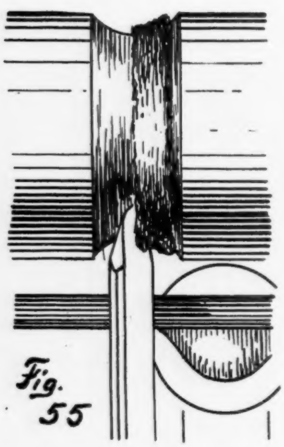


Fig. 55

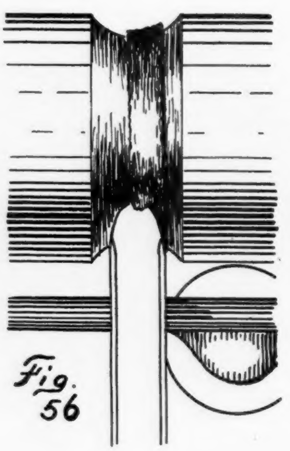


Fig. 56

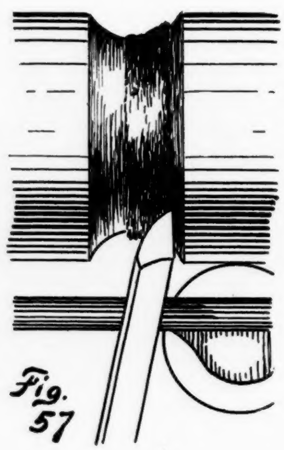


Fig. 57

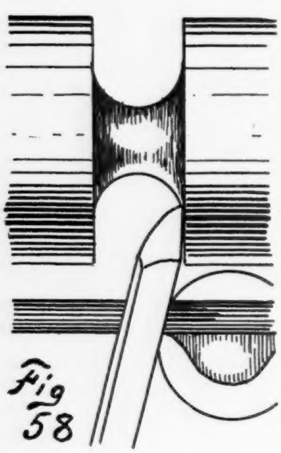


Fig. 58

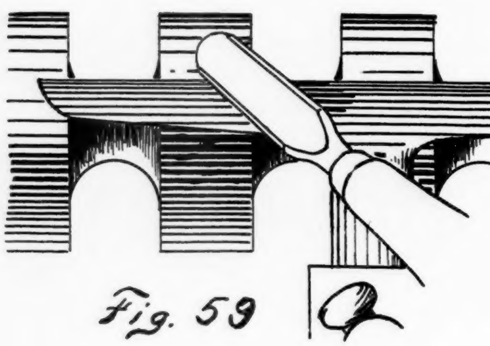


Fig. 59

will be noticed that the sides of the curve, are straight for nearly half the depth.

Finish all concave curves first. These curves may be tested with a piece of wood cut to a circle of $\frac{7}{8}''$ diameter. Mark the edge of the circle with a very soft pencil, and place the piece of wood, or templet, as it is generally called, against the curve turning the templet slightly. Any high places in the curve will be blackened by the lead from the templet. These high places are to be turned down, until the edge of the templet exactly conforms to the concave curve.

The convex portion of the compound curve is also to be cut with $\frac{1}{2}''$ gouge. The position of the tool is shown in Fig. 59. For this work the gouge is held very nearly as the skew chisel was held in turning the beads in the fourth exercise. The under bevel, which must be ground perfectly straight bears on the surface to be cut. The handle of the gouge is raised, and swung round very nearly as the skew chisel was, but to a greater extent. If the amateur has mastered the turning of beads with the skew chisel, he should have little difficulty with this part of the exercise.

This exercise and the exercise on beads are very important, and should be practiced until the amateur has reached a good degree of proficiency. The principles involved in these exercises will be made frequent use of in the series of useful articles that are to be described later.

The next exercise will be that of turning a tool handle, sketches being given of handles for files, carpenters chisels, screw drivers and turning tools. These handles may be made from any hardwood that does not easily split in driving on centres. Hickory, ash, maple, and birch are the words generally used for this work. Ferrules for these handles may be made from brass tubing in the following manner. Place the tube on a wooden arbor (usually turned from one of the pieces used for the handles) which should pass easily within the tube and is parallel, except at one end where the arbor tapers slightly outward to hold it. The width of the ferrule is marked upon the revolving tube with the points of a pair of dividers, after which a thick acute-pointed tool is used to divide the whole, beginning at one end. The bevel on the left side of the tool is held at right angles to the work, thus leaving every ferrule with one true flat end.

The following table of speeds will be found useful for some of the following exercises.

Diameter of Work.	Revolutions per Min.
1 inch,	about 3000
2 "	" 1800
3 "	" 1500
4 "	" 1200
5 "	" 1000
8 "	" 600
10 "	" 600
12 "	" 500
18 "	" 300
24 "	" 250

In each case the speed should be slower, by one change of the belt on the cone pulley, when the work is started and until it has been turned to a circular shape. When the work is turned plankwise, as is the case in screw-centre and face-plate work, the starting speed should be slower by a second change of the belt.

At a recent meeting of the British Instution of Mechanical Engineers, Mr. H. F. Donaldson submitted a paper giving the results of some experiments on the operation of machine tools. These experiments cover fourteen different qualities of material, including steel, wrought iron and cast iron, and five yellow metal alloys of different degrees of hardness and chemical constitution. The angles of the cutting edges of the tools range from fifty-seven and one-half degrees to seventy-five degrees. The experiments were all made with pointed roughing tools. During the work data were obtained with regard to the actual weight brought to bear upon the point of the tool when cutting. The results of the tests are given in tabular form, but the work is not yet considered complete. They show that when working with a high speed of material, a light cut and a fine feed, different angles are required to those found most suitable for heavier gear with slower speed of material and a coarser feed. The harder the metal, the more obtuse must be the angle of the tool.

A regular system of wireless telegraphy has been established between Martinique and Gaudeloupe. The system, it is reported is not Marconi's but one devised by the the French engineer corps, and has thus far only been used for government messages.

HOW TO BUILD AN AUTOMOBILE

William M. Francis

I. DESCRIPTION OF DESIGN

In this series of articles will be given directions for building an automobile of about the same design as that used in a great many French and American automobiles of the tonneau class. The various parts have been taken from stock parts of dealers in automobile supplies. Patterns were made and steel castings obtained for such parts as could not be purchased. These patterns had stock enough allowed so that either a plain bearing could be used or cups could be made or fitted.

For the speed changes, stock gears were used with steel clutches shrunk on the hubs. This makes a rather long gear case but is not expensive and is easily made. The reason this form of change gear was adopted was that in the sliding gear type, where the gears have to slide into mesh with one another in order that the edges of the teeth may not become bruised or broken off, the gears have to be cut of solid steel and hardened. As case-hardening only hardens the surface of the metal, while underneath the skin it is still soft, the gears will still be deformed, therefore such gears should properly be of tool steel, tempered, making them expensive. Friction clutches, on the other hand, have a great deal of machine work on them, so cast iron gears were used, and the dimensions of the gear case is as shown in Fig. 1. When the detail description is reached it will be shown how to make a much shorter set of gears by using wrought iron. For the differential gears stock gears were also used for the larger sizes but the smaller ones had to be cut special.

The engine used is of the three cylinder, air cooled type, with cranks at 120°. The dimensions of each cylinder are 3″ bore by 4″ stroke. At 1200 or 1500 revolutions per minute, this gives 7.5 to 9 horse power according to how it is rated. Ratings used by different makers vary within these limits, but in either case there will be enough power developed to climb any hill or get speed in excess of that allowed by law.

As shown in Fig. 1, the engine is placed low on the frame in order that it may get as much air circulation as possible. A fan is also shown which may be put into use in using the slow speeds in hill climbing, etc.

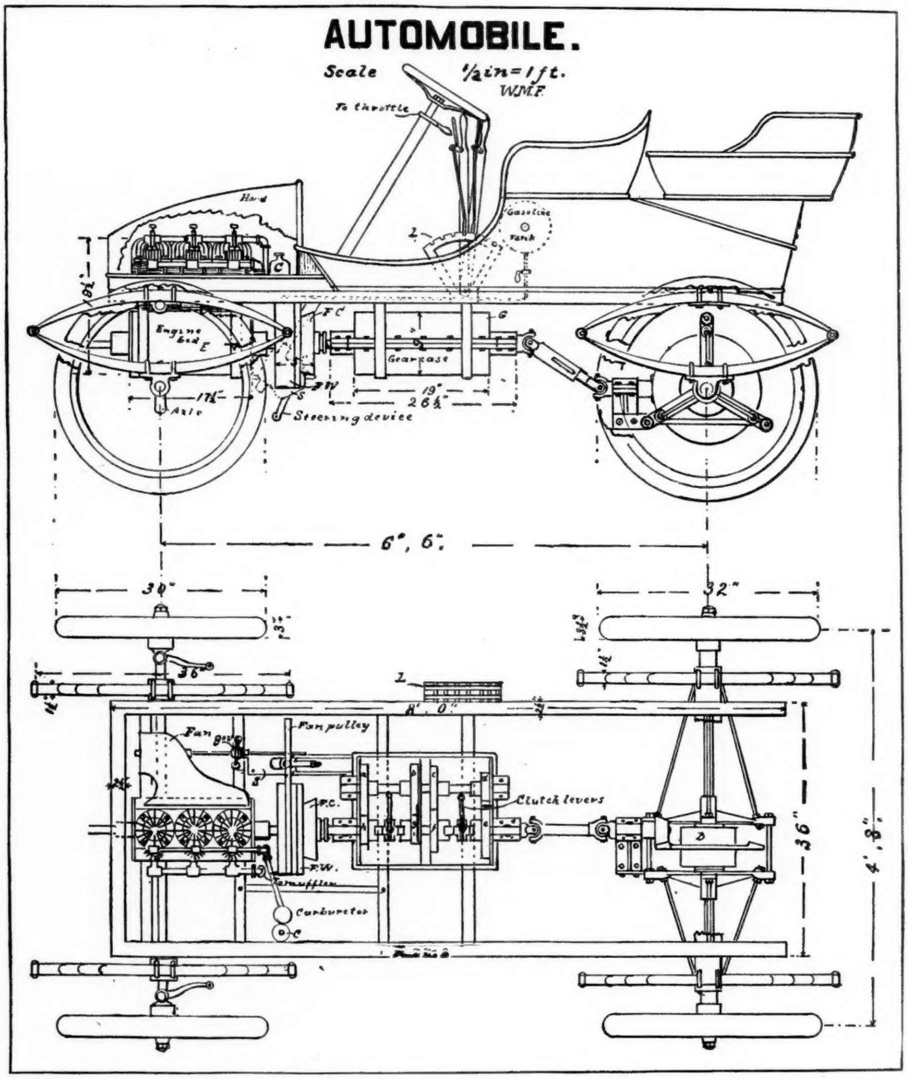
The wheels shown in Fig. 1, are of wood with artillery hubs. The centres have been left out in the drawing in order that the arrangement of other parts may be more plainly seen. It is not necessary to use this style of wheel, as it is a matter of choice whether wood or steel wheels are used. As the rear wheels have more weight to support, these are 32″ diameter with $3\frac{1}{2}$″ tires, while the front ones are 30″ diameter with 3″ tires.

This will put the frame 1″ out of level but when the carriage is loaded it will about level up. The springs used are standard pattern 36″ long by $1\frac{1}{2}$″ wide with 4 leaves. In order to show the dimensions of the spring, in the drawing they are shown as though there was no weight on them. As a matter of fact they will compress 2″ or $2\frac{1}{2}$″ which will also reduce the angle shown to be assumed by the universal coupling shaft leading from the gear case to the differential.

In Fig. 1, the machine is shown without some of the levers, rods, braces, etc., in order that a clearer idea of the general design and principal parts may be had. A drawing showing all parts assembled is somtimes very confusing even to those who are accustomed to the great number of lines, dotted and otherwise, that cross or run into one another so that it is almost impossible to follow them.

The parts as the description progresses will all be illustrated separately and with all dimensions given.

After the frame, axle and wheels are completed an engine of a different type may be used. It is, however, better in building a machine to decide beforehand just what engine is to be used, as it may influence the whole frame work, though in many cases it will only alter the smaller braces of the frame, which in any case, will have to be fitted to the machine and main frame used.



A successful imitation marble has been invented in Denmark. The best imitations have hitherto come from Sweden, but the artifical stone would not keep its shape, and the veins are said to have been stiff and angular. The new product, which is the discovery of M. Schongaard, of Copenhagen, is reported to successfully reproduce the soft transitions of color of the best variegated marble, and to last as well as the real stone, while its cost is about one-tenth as great. A slab half an inch in thickness can be made at 14 cents a square foot. Columns, capitals and moldings can can be manufactured from it as easily as flat slabs.

It is said on good authority that only six to fifteen per cent. of the coal consumed in the production of steam for power purposes is utilized under present conditions, the balance being wasted in smoke, radiation, and in other ways, a large proportion of loss being represented in the exhaust from the engine.

LAWN OR GARDEN ROLLER

The approach of Spring leads one to think of the care of lawns, tennis courts and other surfaces which are desired as level as possible.

A stone roller is rather expensive and a good substitude for one will undoubtedly interest many readers of this magazine. The method here presented for making a roller is inexpensive, and the roller will be found to answer the purpose very well.

First obtain two round cheese boxes 18″ in diameter and as nearly round and matched as possible. The covers are not needed. Place the open ends together and make a line lengthwise of the joints of the sides. Saw along this line through each box to the end and remove the lap ends. Again place the boxes together and on the outside put four 2″ strips of wood and bind together with rope or wire in four places as shown in Fig. 1, twisting the rope or wire tightly during subsequent operations. One strip of wood should be placed over the saw cut.

Find the exact centre of each end, bore 1″ holes therein and remove one end, first marking its position so that it can be replaced in the same position it was taken from. Obtain a piece of 1″ round iron or soft steel shafting 6″ longer than the long diameter of the boxes, drill six or eight holes 2″ apart in the central portion of a size to receive the same number of large wire nails with a drive fit. These holes are drilled at different angles so the nails will project in varying directions.

Place one end of the rod in the hole in the closed end of the box, cut off one-third of the end which was taken off and then replace, with the other end of the rod projecting through the hole. Wedge the rod so the ends will project equally at each end of the box, stand the box on end and fill it full of Portland cement mixture. This should be one part cement to two parts dry, clean sand, and enough water to make it work easily. Mix the cement and sand thoroughtly together before adding the water. In filling the box, small stones may be added to reduce the amount of cement used, but the stones should be well surrounded with cement and none on what will be the surface of the roller. After filling the box, let it stand for about a week to harden, wetting down with water occasionally.

While the cement is hardening the frame can be made. If a strong lawn-mower handle can be purchased, the harder part of the work will be avoided, the remaining part being simply a square frame of oak 2″ x 2½″ with mortised joints as shown in Fig. 2. The bearings for the rod may

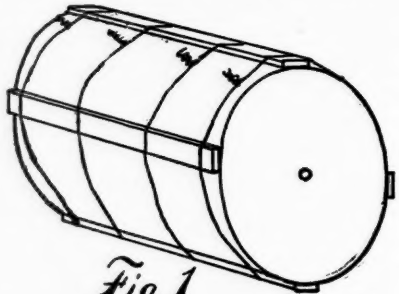


Fig. 1

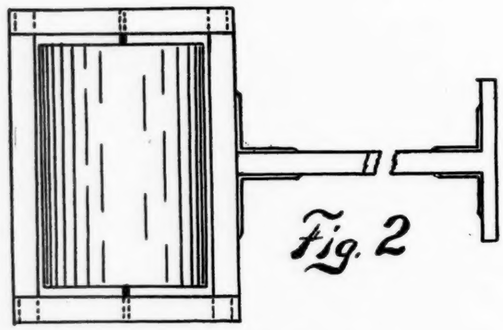


Fig. 2

Lawn or Garden Roller

be simply 1″ holes bored in the ends, but these will soon wear loose necessitating a new frame, so it is better to bush the bearings with brass tubing set in with a drive fit. One end of the frame must not be permanently fastened until after mounting on the roller. Boxes for the bearings can easily be made by fastening to the under sides of the ends, with bolts, two pieces 6″ long and same size as frame, and boring the holes for

the rod so that half of the hole will be in the frame and half in the piece underneath.

If a handle to a lawn-mower cannot be had, a handle can be made of oak 2″ square, well braced with angle irons where it joins the frame and handle bar, the joints also being mortised. Angle irons at the corners of the frame will add to the strength of the roller.

When the cement is dry the box is removed, any rough projections hammered off and the frame mounted. An occasional oiling of the bearings will greatly reduce their wear.

NEW MICROPHONE TRANSMITTER

A new form of microphone transmitter has been devised by Robert Lucke of Magdeburg, in which the pressure between the carbon particles is obtained by electromagnetic action. To obtain good results with a microphone, the diaphragm should be able to vibrate freely in order to correspond exactly to the sounds of the voice. In the case where granulated carbon is used this cannot always be carried out, as the membrane cannot oscillate easily, and in some cases presses directly against the carbon grains which oppose its free motion. In the new microphone the diaphragm can vibrate freely and at the same time act upon the granulated carbon and increase the conductivity. This is carried out by using a hollow cylinder of non-conducting material, glass or porcelain, which is filled with a mixture of granulated carbon and iron filings. The air in the cylinder is exhausted to avoid combustion and obtain a greater mobility of the particles. Behind the cylinder is a magnet, while in front is fixed the diaphragm.

The effect produced by this combination is the following: Each time the membrane is spoken against, its vibrations make it approach and recede from the mass in the mixture of filings and carbon, the magnetism of the the former is increased and the pressure thus exerted upon the carbon becomes stronger, increasing the contact and diminishing the resistance of the cylinder. The latter has an electrode at each end, which is connected to the receiver. When the diaphragm recedes from the cylinder the contrary effect takes place. As it is separated from the tube by a layer of air the diaphragm can vibrate freely. Thus the microphone effect is carried out, not by ordinary pressure of the plate upon the mass, but by a pressure produced within the mass itself.

SCIENCE NOTES

In the Algerian Sahara, are oases where living is maintained only by constant battling with the shifting sands, yet the oases of Souf contains an industrious population of over 22,000, owning about 7000 camels, 50,000 sheep and goats. About 200,000 palm trees also thrive, but the ground had to be hollowed out where they were planted so the roots would reach ground water. Some of the sand ridges are as high as the trees they surround, and as the wind blows the sand freely, continual labor is required to keep the sand away from the trees. In spite of these obstacles, the people are in an advanced stage of culture, and their caravans maintain considerable trade across the desert.

Scientists have discovered that cow's milk a few hours old, contains a smaller number of bacteria than when fresh from the cow, and that fresh milk ordinarily contains but few of the organisms which later cause souring and coagulation. This would indicate that milk will keep longer if covered so as to prevent organisms from reaching it.

In the Sacramento mountains in New Mexico, there grows a grass termed by the ranchmen "Sleepy Grass" from its peculiar effects when eaten by cattle. Horses, after eating heartily of it, drops into a profound slumber, from which they cannot sometimes be aroused fully for several days. This seems to be the only effect which comes from eating it, as no other symptoms of poisoning are exhibited. Amusing stories are related of the prediciments that travellers have found themselves in, when visiting the country for the first time and allowing their horses to eat the grass, and suffering enforced stops of several days owing to the inability to awaken them.

A Swedish inventor has perfected a process for converting the waste wood and saw dust of the mills of that country into charcoal.

The Fifth International Congress for Applied Chemistry is to be held in Berlin from June 2 to 8, and the United States has been invited to send delegates.

AMATEUR WORK

63 KILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

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TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

MARCH, 1903.

Those of our readers, who are still attending school should not fail to give much consideration to the study of mathematics if they propose in after life, to follow any mechanical or electrical vocation. The advisability of so doing may not be apparent at the present stage of their progress, but will become more and more evident as the higher and more intricate studies are reached. Then will the absolute necessity of a ready command of the higher mathematical processes make itself manifest. It is useless to expect success without having a solid foundation of mathematical knowledge, and the easier and better way is to thoroughly acquire this knowledge during school-days when time and instruction can most conveniently be commanded.

From the many highly complimentary communications recently received, we are encouraged to believe that our efforts are being appreciated, and that Amateur Work is accomplishing something of the purpose for which it was begun. Stimulated by this encouragement it will be our aim to increase its value and usefulness by improvements in its mechanical as well as literary features; broadening its scope and enlarging its volume as rapidly as possible. With this end in view, and for the purpose of interesting younger readers, a Junior Department has been opened in this issue giving information and instruction, easy of comprehension and acquirement by the younger readers. We are pleased also to announce, beginning in the next issue, a series of articles on Electrical Instruments, which will be of great value to those interested in electricity and electric battery construction.

The attention of machinists is directed to a new and growing field for remunerative work; that of automobile repairing. The rapidity with which the use of automobiles is increasing, and the fact that many owners personally operate their own machines and therefore, require occasional supervision and repairs by experienced mechanics, will develop an excellent opportunity for the competent machinist, who cares to engage in work of this kind. To do this, he should visit automobile salesrooms, garages and repair stations, learning all he can of the make up and operation of the different types of machines, and thus become competent to inspect and keep in repair the machines that are owned in his locality. An increasing number of owners, who would be pleased to pay a small monthly fee for such work, will enable the machinist who wants this kind of work, to add materially to his income.

PLEASED WITH HIS PREMIUM

A subscriber sends us the following acknowledgement of what he thinks of the premiums sent him for securing subscriptions. The premiums were No. 51, Hack Saw, and No. 86, Combination Saw Set.

Cambridge, Mass. Mar. 7, 1903.

I received today, the premiums which were sent me for securing two new subscribers, and I wish to thank you very much for them. They are most certainly very desirable in every way, and you are evidently determined to amply reward the senders of new subscriptions.

Sincerely yours,

F. L. B.

A MODEL ELECTRIC AUTOMOBILE

William H. Hazard

The automobile which is described in this article has been recently built by the writer, and has proved to be a very interesting source of pleasure to himself and many friends who have seen it. Any one making it should, first of all, carefully study the diagram so as to have clearly in mind the general shape, then the construction will be much easier.

The frame-work can best be made of strip brass, 1-4″ wide and 1-16″ thick. This can be obtained at most hardware stores. The four pieces of brass *AA* and *BB*, two pieces to each side, are 10″ long. They must be put one on top of the other, the flat where the holes are to be bored to rivet or bolt framework together. Small machine bolts with nuts can be obtained at the hardware stores and are much preferable to rivets. Note the small diagram marked "Bearing for holding back axle." For this, use the small size of brass sash curtain holder or fixture marked *S*, and bolt the ends marked *TT*, to the frame 1-2″ from the back end of the side strips *AA* and *BB*. Through these curtain fixtures *S*, put the back or driving axle, *EE*, which is a piece of round steel 1-4″ in diameter and 8 1-2″ long. This you will notice leaves 1 5-8″ of axle projecting outside the sides of the

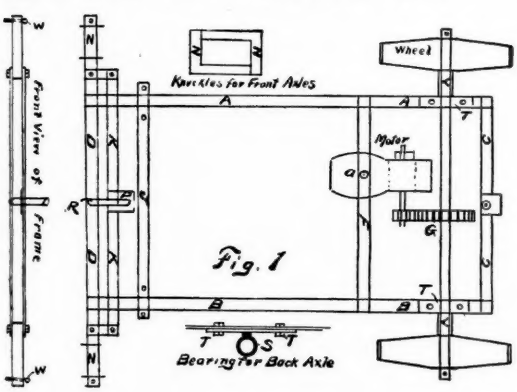


Fig. 1

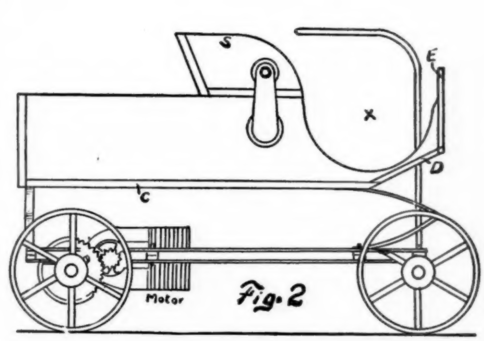


Fig. 2

sides together, in order to make the frame substantial enough to hold the motor. The back bars, *CC*, and the cross piece *F*, are 5 1-4″ in length, the latter giving strength to the frame and holding the motor in place. The two strips *DD*, which hold the front axles, are 6 1-2″ in length. The two strips *J*, which are used to stay the frame and also to hold the ends of the front springs securely in place, should be made 5 3-4″ in length extending 1-4″ beyond strips *AA* and *BB*. This is done in order that there may be room on the extended ends for bolts fastening the two strips together. On this strip *J*, 1-4″ from the sides *AA* and *BB*, bore two holes and insert bolts. This serves to strengthen the spring and also the frame. Carefully note the small circles which are put at various places on the frame. These are frame. Put collars made of brass tubing over the axle between it and the wheels.

On the axle put a gear of 55 teeth, or eleven times the number of teeth on the gear to be attached to the shaft of the motor This gear should be driven on with a tight fit to hold it in place.

For wheels use those which are commonly put on carpet-sweepers. These answer the purpose very well, for they have rubber tires. They can be obtained at any shop where wringers and sweepers are repaired. Set the back wheels on the axle 1-4″ from the outside end. A small motor such as is usually sold for about one dollar can be used for this automobile. Through the base of this motor bore a hole *A*, and insert a bolt, one end of which is to be put through a hole in the brass strip marked *F*. Note that the motor

must lie flat so that its gear will fit the gear of the back axle. Be very careful about this point, for if the gear does not fit nicely, a great deal of power will be lost.

The part of the running gear *DD*, serves as the front axle frame. To either end of this axle frame attach the steering axle *NN*, which may be cut out of a piece of brass, 1 3-4 ″ long, 1 ″ wide and 1-4 ″ thick, with a hack saw. Each axle is made with an arm 3-4″ long at a right angle to the axle. After cutting out, the axles may be turned or filed round to fit the wheels. At the apex of the angle bore a hole, and also at the end of the short arm. Through the holes at the apex are put bolts, which also pass through holes in the ends of the pieces *DD*, holding the axles and yet allowing them to be turned. The ends of the short arms are to be connected by small bolts with a strip of brass *KK*, 6 1-4″ long and 1-8″ thick. At the centre of *KK*, rivet or solder a piece of thin brass *P*, 3-4″ square. Through this plate bore a hole near the center and fasten it by means of a bolt, to one end of a brass arm 3-4 ″ long and 3-8 ″ wide. To the other end of this arm, at the point *R*, between the upper and lower strips *DD*, is fastened the lower end of the steering rod. Make the steering rod out of steel wire 1-4″ in diameter and 8 1-2″ in length. This rod passes through the body of the automobile just back of the dash board. At a point 3″ from the upper end, bend it at an angle which will make the handles suit the position of the seat.

Put the front wheels on the front axles *NN*, these being turned so as to have the wheels run smoothly. Fasten the wheels on the axle with cotter pins [see *WW*,]or the ends can be threaded and nuts used. On the back strip *CC* of the f rame, fasten a piece of lock spring in the form of a diamond. This will furnish the back spring. For the front springs bend two pieces of the same material in the shape of a wishbone, attaching one end of each spring to the end of the strip *J*.

When you have completed the running gear or frame, it would be well to put on a coat of black enamel paint, which when dry should be rubbed lightly and evenly with the finest grade of sand paper. Then apply another coat of any desired color. It is better to use enamel paint than to use dry color and varnish it afterwards.

The body of the automobile can be made of whitewood 1-4″ in thickness and can be obtained of any carpenter or planning mill. A piece 24″ long and 12 ″ wide, will be sufficient to answer all requirements. First cut out two side strips 10″ long and 2″ wide, in the shape shown in Fig. 2,. The curved part of these can be cut with a fret-saw. The strip *C*, is the bottom of the body, being 1-4″ in thickness, 8 1-2″ in length and 6″ wide. The bottom piece *D*, is 1 1-2″ long and 6″ wide.

For the dash board saw a piece 2 1-4″ wide and 5 3-4″ long. This overlaps the second piece of the bottom or floor under the driver's feet. As there is little or no support to the dash board, take two strips of thin brass 3-4″ wide and 5″ long, and bend them to fit the angle made by *D* and *E*. Bore two holes in each part of the brass, and through the woodwork of the floor and dash, and fasten with brass screws making the dash very strong. The seat consists of four pieces, two pieces for the sides 1 1-2 ″ between top and bottom. The back is made of a piece 6 3-4″ long and 1 1-2 ″ high, the bottom is 2 3-4″ wide and 5 3-4″ long. The tail board is 5 3-4″ long and 2 1-4 ″ wide. This can be nailed or hinged on.

The wiring should be done as follows: Place a binding post at the left side of the seat and just below it on the body proper, place the switch handle. The end of your switch handle should cover the head of the binding post and make a good connection. Connect the motor with the battery, then the pole of the switch arm with battery, then motor with binding post on side of seat. This wiring is the same as the ordinary push button bell circuit. On the slanting piece of the body (bottom) place a small socket and miniature electric light bulb. For a gong, get an electric buzzer. Both gong and electric light can be connected with the batteries. Get two night lamp batteries for supplying the current. These must be of proper size so that they will fit in the body and are connected in parallel. The "auto" thus carries it own power and will work nicely on a large table or the floor.

The engineers of the Spanish Government are installing Westinghouse motors in their gun shops at Trubia, and the Spanish Arsenal at Ferrol is also shortly to be equipped with a number of motors and other electrical machinery.

STUDIES IN ELECTRICITY

XVII. ALTERNATORS

An "Alternator" is the designation commonly used to indicate an alternating current generator.

The armatures of alternators do not differ greatly in external appearance from those in direct current generators but the winding and connections are different. In some types of alternators the armatures are stationary and the fields revolve.

As has been previously stated, to secure the required "frequency" and at the same time a comparitively slow speed to the armature, alternators are usually constructed with from 16 to 24 poles in the field and a similiar number of coils in the armature, the latter being connected in serres and in parallel according to the E. M. F. and current required.

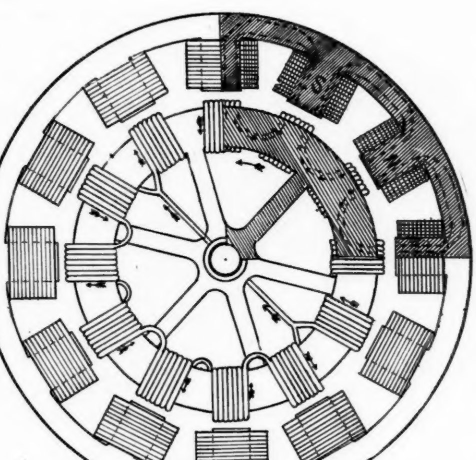


FIG. 38

Fig. 38 shows the plan of construction of a ring multipolar alternator. The dotted lines show the lines of force of the field. Each coil is wound in the opposite direction from those adjacent, so that the currents will flow in the same direction, as the coils pass under the poles. If all the coils were wound in the same direction the E. M. F. generated by one coil would oppose that generated by the adjacent ones unless the coils were connected in such a manner as to secure a different result.

The width of the coils and pole faces are made about equal, the maximum current being generated when the coils are directly opposite the poles. Notning is gained, therefore, by having the coil windings of larger area than the pole faces, any excess winding adding to the resistance. As the armature revolves, the coils successively pass under the N and S poles, the current being a zero when the coils are between the poles, at a maximum in one direction when central under N poles, and at a maximum in the other direction when under the S poles.

The current is collected and connected with the external circuit by bronze or brass collecting rings or collectors, mounted on the armature shaft but insulated from it and each other. The brushes have a sliding contact, making this part of the machine of much easier construction than the commutator of a direct current dynamo. Other forms of alternators have drum windings and also disc armatures, the construction of different types being best learned by visits to electric lighting or street railway power stations. The field magnets of an alternator are usually excited by a small direct current dynamo, sometimes mounted on the shaft of the alternator, or separately mounted, and driven by a belt from the shaft.

When two or more alternators are supplying current to an external circuit, it is customary to connect them in parallel, unless the plant is large enough to require separate machines for the different circuits.

When connected in parallel they will have a constant tendency to keep *in phase* or *in step* with each other, the opposite being the case when connected in series. When connecting into the circuit an additional machine, it is first necessary that the machine to be connected shall be in phase with those already supplying current to the circuit, i. e., they must be in *synchronism*. There is then

but little disturbance to the operation of the other machines. To do this, the machine is first brought up to the correct speed as indicated by a *synchroniser* and then switched into the circuit.

The current generated by an alternator is usually of a much higher potential or voltage than that required for use, therefore, it is reduced at some convenient point in the circuit by means of a *transfomer.* Alternating current transformers are constructed much like induction coils, with iron cores, primary and secondary coils. In this case, however, the primary is made up of many turns of fine wire, and the secondary of a few turns of larger wire. The high potential current in the primary is thus reduced to a larger current of lower potential in the secondary; the latter being connected to the service circuit.

In the larger cities, the high potential current is conveyed to a central point in the service circuit, and there reduced by a large transformer. In scattered districts, small transformers are introduced into each house circuit. The windings of a transformer are in inverse ratio to the voltages.

If a current of 50 amperes at 110 volts is desired from the secondary, the primary must receive slightly more than 5.5 amperes at 1000 volts.

There are slight losses in thus transforming currents from one potential to another, the efficiency being in the smaller sizes about 95 per cent. rising to 98 per cent. in the larger sizes.

TOOL EQUIPMENT FOR AMATEURS

The amature wood-worker does not always quite know what is desirable in the way of a tool equipment. The following list will give a general idea of the more necessary and desirable tools, though changes and additions will undoubtedly be necessary for those who make a specialty of some particular line of work. The list will be helpful, however, to those who are making up an outfit and are in doubt as to what tools should be purchased.

1 Panel saw, 18 inch
1 Panel saw, 24 inch
1 Rip saw, 26 inch
1 Back saw, 10 inch
1 Back saw, 14 inch
1 Keyhole and compass saw set
1 Smooth plane
1 Jack plane
1 Short fore plane
1 Long fore plane
1 Jointer plane
1 Block plane
1 Set bead planes, assorted, 1-8 to 1 inch
4 Pairs match planes, 1-2 to 1 inch
1 Nosing plane, 1 inch
1 Filletster plane
1 Grooving plow plane, with assorted irons
1 Rabbet plane
2 Saw files, assorted
1 Cabinet file
1 Cabinet rasp
1 Marking gauge
1 Oil stone, boxed
1 Brass oil can
1 Pair flat nose plyers
1 Pair round nose plyers
1 Pair side cutting plyers
1 Drawing knife
1 Cast steel shingling hatchet
1 Cast steel bench hatchet
1 Diston's saw filing vise and frame
1 Two foot steel square
1 Mahogany plumb and level, 2 side views
1 Plumb bob
3 Screw drivers, assorted
3 Brad awls, assorted
1 Adze eye nail hammer
1 Improved monkey wrench
2 Steel nail sets
1 Set of 12 firmer chisels, assorted, 1-8 to 2 inch
1 Set of 6 socket firmer gouges, as- 1-8 to 2 inch
1 Mortise gauge
1 Pair steel dividers
1 Pair steel calipers
1 Carpenter's ratchet brace
1 Set of 6 small auger bits, assorted
1 Set of 12 steel brace bits, assorted, 1-8 to 2 inch
1 Rosewood try and mitre square
1 Tool handle containing tools
1 Sliding T bevel
1 Pair compound nippers
1 Hickory mallet
1 Improved saw set
1 Two-foot caliper rule
1 Chalk line, reel and awl
1 House carpenter's broad axe
1 Spokeshave
1 Bench vise
1 Iron bench screw
1 Improved bench stop
1 Panel gauge
6 Hand screws, assorted
1 Each flat, cape and round-nosed cold chisels
1 Adze eye brad hammer
1 Hack saw frame and blades
1 Wood rasp
3 Flat bastard files, assorted
2 Half ronnd bastard files, assorted
1 Pipe wrench
1 Pipe cutter
1 Pair tinners snips
1 Steel brick trowel
1 Expansion bit, 1 1-2 to 3 inch
1 Riveting hammer
1 Machinist's hammer
1 Set 9 steel twist drills, assorted
1 Breast drill
1 Glue pot and brush
1 Measuring tape, 50 feet
1 Carpenter's pencil

QUARTER H. P. HORIZONTAL ENGINE

B. R. Wicks

II. THE VALVE CHEST

After the cylinder has been bored, faced, and the four sides turned off, holes will have to be drilled and tapped in the two end flanges to hold the cylinder covers, and four 1-4 " holes tapped in the side of the flanges to receive the four 1-4 " studs which hold the valve chest to the cylinder, but this latter operation, cannot be done until the valve chest C, 355, had been machined. This may now be done. The casting has a 17-32 " cored hole its entire length, which is to be bored out to 5-8 ", the diameter of the valve chest. Chuck the casting by one of its ends, and with a boring tool in the slide rest, bore out to a little less than 5-8", then ream out with a 5-8 " hand or lathe reamer. This hole must be absolutely straight and smooth.

It can be bored another way if perferred. Chuck the casting and see that it runs true with the cored hole; put a V shaped tool in the slide rest and enlarge the hole to receive a 39-64 " drill. This drill can be held by the use of a dog and the tail stock centre, or in a chuck fitted to the tail stock. Feed the drill in slowly and when through, run in a 5-8 " machine reamer .005" under size, and finish with a 5-8 " standard hand reamer. When the hand reamer is used take the casting out of the chuck and hold it in the vise and run the reamer down with a reamer or tap-wrench by hand.

After the boring of the valve chest chamber is done, drive in the hole just bored a 5-8" mandrel, place between centres in the lathe and turn and face. The length of the valve chest proper is 2 1-2 ", the same length as the cylinder, but on each end is an extension 1 1-4" diameter and 9-16" long. To accommodate the valve and the exhaust steam outlets and the valve chest covers, turn the two ends 1 1-4 " diameter and 9-16 " long, making the total lenght of the valve chest 3 5-8" from end to end. In facing the flanges be very careful to get them central with the centre of the steam inlet boss and 7-16 " wide. Replace the casting in the chuck, taking the greatest of care to see that the ends run dead true in the chuck with the 5-8 " bore. When this position is located put a small square pointed boring tool in the slide rest, set a pair of inside calipers to 3-4 ", and bore to the depth of 1-8 " and 3-8 " diameter to allow the valve chest covers to set in their proper places. This must be done on both ends.

The four sides of the valve chest must be turned to 1 5-16" x 2 1-6", but on account of the two extensions on the ends it cannot be turned with the same fixtures as the cylinder. Have at hand a pair of small V blocks. Place a V block under each of the 1 1-4 " x 9-16" ends on the face plate, and put in the 5-8 " bore a piece of 9-16 " cold rolled steel long enough to get a clamp or strap on each end to hold the casting in position while facing. Place a round-pointed tool in the slide rest and set it 1-16 " from the 1 1-4 " round end. Take this cut, then set the tool to 1-32 " and take the last cut on this side with a very fine feed. This cut will bring the centre of the valve chest 21-32 " to the point of the tool, making the correct measurement of 21-32 " from the centre of the valve chest to the outside of the flange. The castings will now be turned on the V blocks to turn the top side which will be 13-32 " from the 1 1-4 " round ends. In turning this side over be very careful the part just turned is square with the face of the face plate.

Remove the V block and fasten the casting direct to the face plate and turn off the last flat side to 1 5-16 " from the point of the tool to the face plate. On the last end side is the boss for the steam inlet. Set the centre of this boss true with the tail stock centre and fasten down tightly to the face plate and finish to 2 1-16 ". Put a small centreing tool in the slide rest and make a centre large enough so that a 3-8 " drill will start true. Drill this 3-8 " hole right through the boss into the valve chest chamber and take particular care not to drill into the opposite side. It will be noticed that there must be two more 3-8 " holes drilled in the two end extensions for the exhaust steam to pass through. These are on the bottom ends. Place the casting with one of the 1 1-4" x 9-16 " ends to the surface plate, and with a surface gauge or scratch block strike a line 9-32 ". Turn end for end and do the same at the other end. Lay the casting down lengthwise, the 2 1-16" ends to the point and strike a line 2 1-32", being the centre. Where these lines cross make a small centre punch mark, and draw a 3-8 " circle. Drill with a small drill first, as the surface is round and the 3-8" drill will probably run off the centre. When the small holes have been drilled, follow with the 3-8 " drill, and tap out with a 1-8" pipe tap union, pipe size. Also tap the hole drilled in the boss with the 1-8" tap.

The steam ports in the valve chest are laid out, drilled, chipped and filed in the same way as with the cylinder, only they are not enlarged to 3-4 " on the inside, but 5-8 " x 1-8 ". There must now be four 17-64" holes drilled in valve chest for the 1-4 " studs which hold it in position on the cylinder. Take the valve chest and lay it down lenghtwise on the surface plate, and with a surface gauge or scratch block, make a line

Note. The illustration of detail and parts of engine will be found in the February issue, page 78, to which letters and figures in this article refer.

9-32 " from the bottom on each end; do likewise with the top. Set it on one of the 1 1-4" x 9-16" flanges. Make centre punch marks where these four lines cross. With a pair of dividers, make a 17-64 " circle around each of the four punch marks for guide circles, showing which way to chip if the drill should work off the centre. Drill these four 17-64 " holes through the flanges. The cylinder must now be drilled and tapped for the four 1-4 " studs. Place the cylinder and valve chest side by side lenghtwise on the surface plate and clamp them tightly together so that in drilling they will not move from position when the starting drill is used. Having got them exactly even with each other lenghtwise, and clamped tightly together, drill with the 17-64 " drill, using the valve chest as a gig, to the depth of 1-32 " of an inch. The holes having been started with the 17-64" drill, drill to the depth of 7-16", no deeper, with a 3-16 " drill. These 3-16 " holes will now be tapped out to 1-4 "-20 thread, U. S. S. This can be done before the clamps are taken off, the valve chest acting as a guide to keep the tap straight. The four 1-4 " studs, No. 366, are cut on one end 20 threads U. S. S. and on the other 24 threads V. The threads on these studs should be cut with dies that are furnished with guides, so that when screwed in position they will set square. Also, they must be good fits in the tapped holes and not be either too loose or too tight.

The cylinder covers and valve chest covers will have to be turned, drilled and fitted. Take first the back cylinder cover, No. C, 356. This casting is provided with a chuck piece and should be held in the chuck by it and turned. Turn the 1-8" x 1 1-2" end that fits the bore of the cylinder so that it will just push in. The outside diameter is 2 ". This is also to be turned to size before taking out of the chuck. Before taking the casting out of the chuck have at hand a sharp pointed V boring tool. Put this tool in the slide rest and make a circle 1 3-4" diameter which will give the distance of 7-8 " from the centre of the cover to the centre of the bolt circle. It is also to be finished on the other side. Remove from the chuck and turn it end for end replacing in the chuck, and finish to 3-16" wide. The centre is to be bored out to 1 1-4" diameter, and 3-16" deep. Polish with fine emery cloth and oil.

The front cylinder cover forms the piston rod stuffing box; also to keep in position the cylinder and cross-head guide. Much care must be taken in turning this piece, and before finishing it will be necessary to bore out the cross-head guide, No. C. 367. This casting is cored out to 1 1-8 " diameter, and is to be bored and reamed to 1 1-4" diameter. Chuck the casting by the 2 3-16" flange, and centre it in the chuck by the cored hole. When this position is located, bore out to 1 1-4" less .005". Take two or three cuts and then ream to standard size with a 1 1-4" hand reamer. This hole must be perfectly straight and smooth and free from tool marks. It would be well, now that the casting is bored, to do the turning required on it. It should be finished all over. Drive in the 1 1-4" hole just bored a 1 1-4" mandrel, and between centres begin the turning and facing operation. Rough the castings out first, leaving all measurement 1-32 " over the sizes given on drawing. This being done, begin and turn the back flange to 2" diameter and face the outside perfectly true, as all the measurements will be taken from this face. Now make this flange 3-16" wide and use a small round pointed tool so as to make a small filet on the inside. With this same tool finish up the body of the cross-head guide to 1 1-2" diameter to the length of 3" from the outside of the 2 " diameter flange. The front flange is 1 3-4" diameter at is largest diameter and 1 5-8" at the point where the rounding takes place. This can be done with a hand tool. Make this flange 3-8" wide, making a total length of the cross-head guide 3 3-8 " from end to end. The body of the cross-head guide should not be polished, as it can be enameled to far better advantage and look better, but the back flange should be nicely polished with emery cloth and oil. Do not file of the spot on the bottom of the front flange yet as that will be attended to later. Having the cross-head guide bored and the turning finished, the front cylinder cover and piston rod stuffing box, No. C, 357, can now be turned and fitted. Chuck this casting by the 1 9-16 " x 1-8 " end. With a centreing tool make a centre in the 1 " x 9-32" end large enough to start in a 17-64" drill. Drill this hole all the way through the casting and finish with a 9-32 " reamer. Before taking the casting from the chuck, drill into the 9-32" hole with a 1-2" drill to the depth of 9-16". This will form the piston rod gland stuffing box. The turning will have to be done between centres on a mandrel that will perfectly fit both the 1-2" hole and the 9-32 " hole. Make a mandrel 9-32" x 1-2" and force it into the casting, and between centres. First rough off the casting leaving it 1-32 " larger than the figures given on drawing. This being done, commence the finishing by turning the end that fits the cylinder, which is 1-2" diameter and 1-8" wide, so that it will have to be tapped in lightly with a small lead or copper hammer. The largest diameter is 2" and the width 3-32 ". Now turn the 1 1-4 " x 1-8 " end that fits the cross-head guide and make the fit tight enough so it will have to be tapped with the hammer. In making these fits do not use either file or emery cloth, but finish with tools by taking light cuts in the slide rest. The piston rod gland stuffing box hub is next finished, and as it fits nothing on its diameter which is 15-16" x 9-32", can be nicely polished. Bear in mind that there must be a 1 3-4 " circle made on this cover, as was done with the back cover, to drill the holes by. The piston rod gland, No. C. 360, is chucked and drilled its entire length with a 17-64 " drill and reamed to 9-32 " with a 9-32 " ream. It is then forced on a 9-32 " mandrel and turned to the dimensions on drawing. The 1-2 " diameter, that fits the hole in the front cover, should be about .001" smaller than 1-2 ", and should be nicely polished all over. This finishes the piston rod gland, with the exception of drilling two No. 28 holes for the two 9-64" studs to pass through, which hold it in position to the

front head. These holes are drilled 11-32″ from the centre with a No. 28 drill. The two piston rod gland studs, No. C, 361, are made from 9-64″ wire and cut with a die, 32 threads. The length of these threads are given on the detail drawing. There must be two nuts 1-8″ wide, one on each stud, to force the piston rod gland in the stuffing box to keep the packing steam-tight.

The valve chest heads No. C. 362, and 363, must be turned, fitted, drilled and polished. Begin with the back valve chest cover C, 362. This casting can be entirely finished in the chuck. Chuck the casting by its largest diameter, which is 1 3-8″. Turn the end that is to fit the valve chest, bore to 3-4″ diameter and 1-8″ wide. Make this an easy fit so that there will be no trouble in getting it out of the valve chest. With a round pointed tool, bore out a recess 5-8″ diameter and 1-8″ deep. This is cut out so that the lock nuts on the valve stem will not strike against the cover. Before taking out of the chuck, make a circle 1-2″ from the centre which is the centre of the bolt circle. Remove from chuck and turn the piece end for end and finish to 5-32″ wide. The smallest diamater of this cover is 1 1-4″ and the largest 1 5-16″. The rounding from 1 1-4″ to 1 15-16″ can be done with a flat hand tool. The piece should now be highly polished with emery cloth and oil.

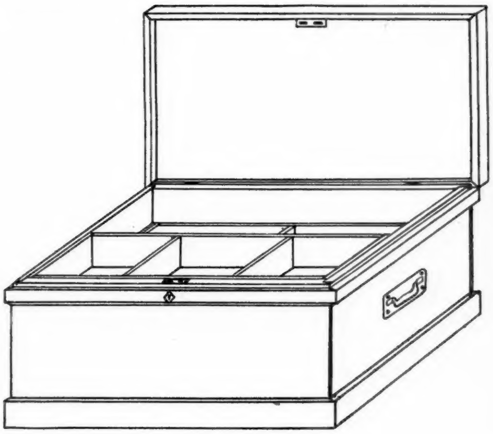
The front cover, No. C. 363, will now receive attention. This cover must be turned on a mandrel between centres after the holes for the valve stem and valve stem stuffing box have been drilled. Chuck the casting and with a centreing tool in the slide rest, cut out a centre large enough for a 3-16″ drill to start true. Drill this hole all the way through, and follow with a 5-16″ drill to the depth of 19-32″. This last hole forms the valve stem stuffing box. A mandrel must be made to fit both of these holes. The end turned to 3-4″ diameter and 1-8″ wide, fitting the bore of the valve chest, must be turned so that it will have to be tapped in lightly with a lead hammer. The rest of the turning is not such a particular matter. Finish to the figures given on drawings and do not forget to make the bolt circle 1-2″ from the centre. Polish highly with emery cloth and oil. The valve stem gland is chucked, centred and drilled out to 3-16″ diameter, and finished up on a 3-16″ mandrel. Use the same rule with this as with the piston rod gland. Drill two holes for the two 9-64″ screws to pass through that hold it in position to the front valve chest cover. These holes are drilled 9-32″ from the centre with a No. 28 drill.

A TOOL CHEST

John F. Adams

A tool chest for keeping one's tools safe and clean should be provided as soon as possible. Rust, the great enemy of tools not constantly used, is greatly lessened if tools are kept in a suitable chest, and sharp edges are also kept in better condition. For some reason, chests made in a substantial manner are sold at rather high prices, and as a good one can be made at small cost, it is desirable to make rather than purchase one. The chest here described will provide plenty of room for an outfit as large as most amateurs are likely to possess. It should be made of chestnut or whitewood, the body finished natural and the mouldings stained with a dark stain. The contrast thus easily obtained gives a very nice, attractive appearance to the chest. The front and back pieces forming the body are 34″ long, 14″ wide and 3-4″ thick. The two end pieces are 15 1-2″ long, 14″ wide and 3-4″ thick.

Rabbeted joints are made by cutting rabbets 3-4″ x 1-2″ in the inside of the ends of the front and back pieces, leaving the wood 1-4″ thick. These joints should be carefully made by first marking out with a marking gauge, sawing carefully just inside these lines and finishing with a rabbet plane. The joints are then glued and nailed both ways with wire finish nails. But before doing this, cut a rabbet 1-4″ deep and 3-4″ wide on the inside lower edges to receive the bottom board. This adds considerable strength to the chest as well as making tighter joints and keeping out moisture. The bottom board is 33″ long, 15″ wide, and 3-4″ thick, fitted and nailed to the rabbets just mentioned with a slight allowance on sides for expansion in moist weather.



Tool Chest

The pieces for the bottom moulding are 35 1-2″ long, 3″ wide and 3-4″ thick for front and back, and 17 1-2″

long, 3″ wide and 3-4″ thick for the ends. The upper edges are beveled slightly and the joints are mitred. The pieces for the upper moulding are of the same length and 1 3-4″ wide; the under edges being slightly beveled and joints mitred. They are glued and nailed to the chest so that the upper edges are a full 1-4″ below the tops of the body pieces. When these are in place run a rabbet plane around the outside of the projecting body, taking off a thin shaving so that the cover will not bind anywhere.

The cover is 34 1-2″ long, 16 1-2″ wide and 3-4″ thick, using single board if obtainable, but if not, two pieces will have to be glued up, using clamps while the glue is drying. The moulding around cover is 1 1-8″ wide and 3-4″ thick, the front and back pieces being 35 1-2″ long and the end pieces 17 1-2″ long. A rabbet is cut in the upper inside edges 1-4″ deep and 3-4″ wide to receive the top board which should fit tightly and be well glued and nailed. The corner joints of the moulding are mitred. The cover should fit the top of the chest so that the mouldings on same will be even with the top moulding on the chest. Two 3″ brass hinges at back, a good lock in front and two strong handles for the ends, complete the chest, with the exception of two sliding trays.

The top tray is the full length of the chest inside, 32 7-16″ long, 7″ wide and 4″ deep. It is made of 1-4″ stock and has two partitions, equal distance apart. The ends should be dove-tailed, the bottom fitted inside the frame and well glued and nailed in place.

The lower tray is 3-4″ shorter than the upper one and has one partition in the centre. The trays slide on ways as follows: To a strip of wood 14 1-2″ long 5″ wide and 3-8″ thick is fastened another strip 1″ wide of same length and thickness and both strips are then screwed to one end of the chest so that the upper edge of the wider strip will be a trifle over 4″ from the top of the chest. Similar strips are fastened to the other end. The upper tray slides on the wide strip and the lower tray on the narrow one.

A saw compartment may also be added and will be found very convenient. Four strips of wood 6″ long 3″ wide and 1-2″ thick are fastened with screws to a piece 32 1-2″ long, 6″ wide and 3-4″ thick. Two are placed at the ends and the other two 8 1-2″ from each end. In the latter two make three saw cuts 4″ long, two 5-8″ from each edge and one in the centre. This frame is then strongly fastened to the front and bottom of chest and will hold three saws in the slots.

After staining and varnishing, brass corner pieces may be added, making the chest stronger and more ornamental. The illustration has the appearance of a wide chest but the dimensions here given will give one correctly proportioned.

HOW TO MAKE A HOT-BED

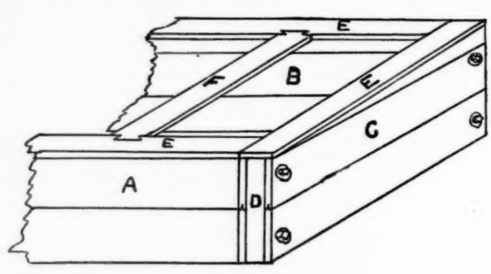
WARREN G. MANNING

A description of a hot-bed used in a small garden for raising vegetables may interest some of the readers of this magazine. If one has storm windows available the cost of making will be very small, but will well repay the expense even if windows have to be purchased. Frequently second-hand sash can be found which will answer. The windows I use are 66″ long and 33″ wide. They are taken from the south and west sides of the house in March, when I set up two frames each taking four sashes.

The frames are made of 7-8″ matched siding, 6″ wide, planed on one side. The front or lower side *A*, is 11′ 6″ long and 12″ high, the back or higher side *B*, is of the same length and 18″ high. The ends *C*, are 5′ 6″ long, 12″ high at the front and 18″ high at the back. By sawing one strip diagonally across its length, the two pieces for the upper part of the ends are obtained. Match up the pieces before nailing to get the matching right.

Each part of the frame is made with two thicknesses of board, nailed to pieces of 2″x 3″ joist *D*, one thickness of board on each side. The joists *D*, are spaced about 31″ apart. On the top edges of the frame are nailed strips of wood *E*, 3 3-4″ wide, these pieces on the sides being at an angle so the sash will lay flat upon them. The bottom edges are left open. The air space between the two thicknesses of boards acts very effectually to keep out the cold.

The ends are fastened to the sides by 6″ lag screws with washers under the heads. Strips of wood 1″ wide are nailed to the inner side of the ends, snug against the sides, to secure tight joints. Strips of board *F*, 6″



HOT-BED FRAME

wide are run across from one side to the other, spaced 2′ 5″ apart to support the sash. The ends of these cross-pieces are dove-tailed into the top strips *E*, of sides, thus holding them securely in place. If the frames

are given a coat of outside paint yearly they will last for years.

To erect them, dig a trench about 6″ deep of the proper shape and size. Place the parts in position and fasten with the lag screws, banking up the earth removed from the trench around the outside. The earth inside the frame is then turned over and shoveled to one end. The supply of manure, leaves, etc., is then placed in the other end and when the fermentation has reached the right point, the mixture is covered with about 6″ of earth and firmly tramped down. It is left a few days to see that too much heat does not develop and then planted. After shoots appear, the sashes should be raised on warm sunny days during midday but closed at least two hours before sunset.

The beds here described are used almost entirely for tomatoes, which are not transplanted, the sashes and frames being removed when warm weather arrives. The plants grow to a large size, are very prolific and over a month earlier than without the hot-bet.

PROJECTION

CARL H. CLARK

VI. PROJECTION OF PYRAMIDS

A pyramid may be defined as a solid whose base is a polygon and whose edges meet at a common point, termed the apex; all its sides being therefore triangles, the axis is the line from the centre of the base to the apex. When the axis is perpendicular to the base it is called a right pyramid, when otherwise, it is called oblique. In this work only right pyramids will be used, the oblique pyramids being left as exercises for the student.

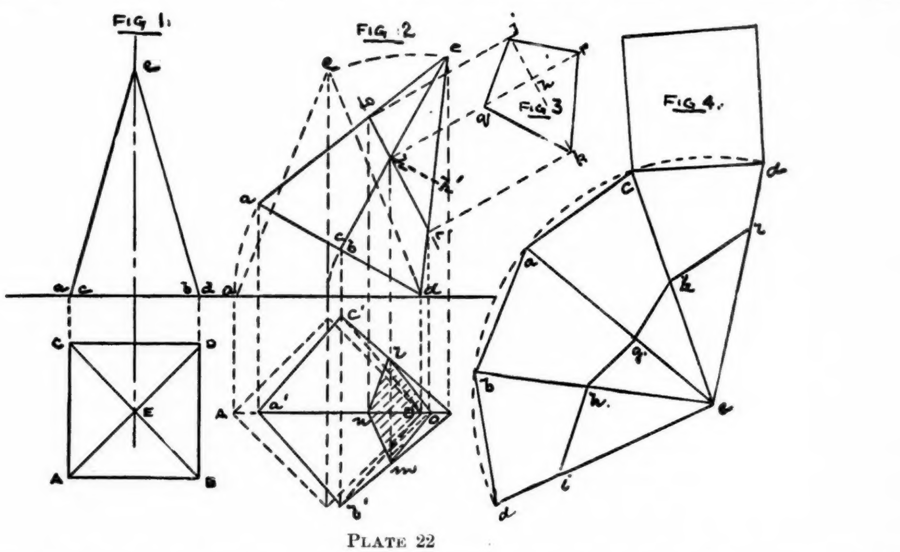


PLATE 22

Referring to Plate 22, Fig. 1 represents a square pyramid, the sides of whose base are 2 ″ each, and whose hight is 4 ″, standing with two of its sides parallel to the vertical plane. It is to be noticed that the apex is directly above the centre of the base.

Fig. 2, shows in dotted lines the same pyramid when one of the diagonals of the base is parallel to the vertical plane, the width of the base *a-d* is the same as *A-D*, Fig 1, and the height also the same. To obtain the plan and elevation of the pyramid when resting on one corner *D*, with the plane of the base at 30° to the horizontal plane, reproduce the dotted elevation by drawing a 30° line through *d*. Now when the pyramid is turned up through 30° all points *a-c a-e*, etc., will travel through arcs of 30° as shown, with *d* as centre, and the new elevation is constructed on the 30° line. The plan is obtained by carrying horziontals through the points in the dotted plan and cutting them with verticals dropped from the points in the inclined elevation. When the corners of the base and the apex are thus obtained, all that is neccessary is to connect them by straight lines.

Sometimes it is desired to find the shape of the solid on some plane which cuts it as *g-h-i*. Now the true shape of any surface is shown only when looking

directly down upon it; therefore draw lines from *g-h-i*, perpendicular to *g-i*, and as a base for the development of this surface [Fig. 3,] draw *j-k*, parallel to *g-i*; *j-k*, is the length of the section. From *g-h-i*, drop perpendiculars cutting the corresponding edges *l-m-n-o* and connect these points with straight lines and a plan of the section iş obtained. Now the distance *l-m*, shows the true width of the section, and if this distance is laid off on *q-r*, one half on either side as *p-h*, and *h-r*, and the points *j-q*, *j-p*, *q-k*, and *p-k*, are joined, the true shape of the section is shown.

To get the development, Fig. 4, of the surface of this pyramid, it is evident that the corners of the base are all equidistant from the apex by a distance equal to the length of one edge *e-a*, so the dotted arc is drawn with radius equal to *e-a*, and from any point as *d*, the distances *b-c*, *c-a*, *a-d*, and *b-d*, are laid off, each equal to a side of the base, and these points connected to the apex by straight lines. On the side *c-d*, construct the square for the base.

shown in the plan do not change, therefore the points in the plan for Fig. 2, are obtained as before, by drawing horizontals through the points on plan, Fig. 1, and cutting them by verticals dropped down from corresponding points in elevation, Fig. 2.

Fig. 4, shows the pyramid after it has been swung in the horizontal plane so that its axis makes an angle of 45° with the vertical plane. This elevation is obtained as has already been done with the previous solids.

To find the true shape of a section, Fig. 3, of the pyramid on a plane through the line *A-D-h-i*, the section can be projected on the other views in the manner shown. Now the length *a-n*, shows the true height, and the breadths in the plan show the true breadths, so that all that is necessary is to draw *A' D'* Fig. 3, and make it equal to *A-D*, in the plan; erect a perpendicular at its middle point, lay off *d-i*, equal to *a-h* in Fig. 2, and lay off *i' h'* parallel to *A-D*, and equal to *i-h*, in Fig. 2, and connect *D' I'* and *A' H'* to complete the section.

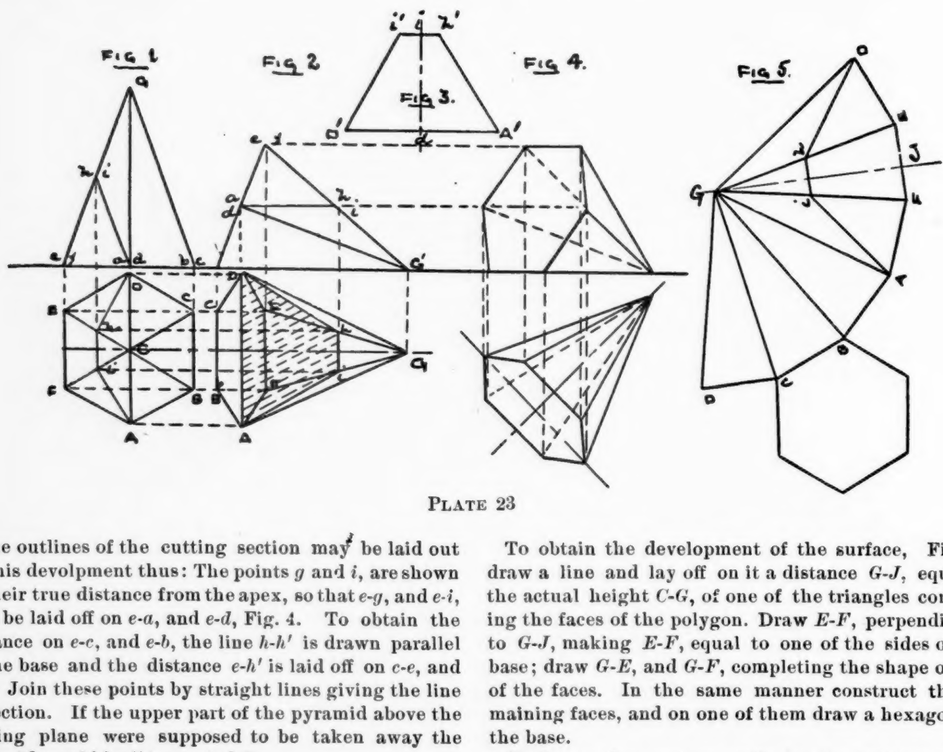


PLATE 23

The outlines of the cutting section may be laid out on this devolpment thus: The points *g* and *i*, are shown at their true distance from the apex, so that *e-g*, and *e-i*, may be laid off on *e-a*, and *e-d*, Fig. 4. To obtain the distance on *e-c*, and *e-b*, the line *h-h'* is drawn parallel to the base and the distance *e-h'* is laid off on *c-e*, and *e-b*. Join these points by straight lines giving the line of section. If the upper part of the pyramid above the cutting plane were supposed to be taken away the pyramid would be "truncated."

Plate 23, shows the various projections of a hexagonal pyramid. In Fig. 1, two of its sides are perpendicular to the vertical plane. Fig. 2, shows it on its side; the elevation is the same as that of Fig. 1, only on its side. It is to be noted that while the pyramid is being tipped over into its new position, the widths

To obtain the development of the surface, Fig. 5, draw a line and lay off on it a distance *G-J*, equal to the actual height *C-G*, of one of the triangles composing the faces of the polygon. Draw *E-F*, perpendicular to *G-J*, making *E-F*, equal to one of the sides of the base; draw *G-E*, and *G-F*, completing the shape of one of the faces. In the same manner construct the remaining faces, and on one of them draw a hexagon for the base.

To locate the section made by the cutting plane, from *J*, set off a distance equal to *e-h*, Fig. 1. Draw *h-i*, parallel to *E-F*, and connect *D-h*, *h-i*, and *i-A*.

For practice the same constructions may be carried out on oblique pyramids, as with the principles already laid down this should be easily done by the student.

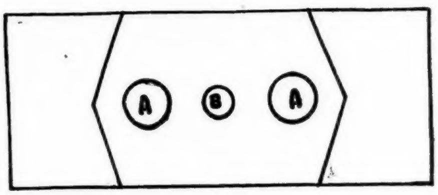
JUNIOR DEPARTMENT

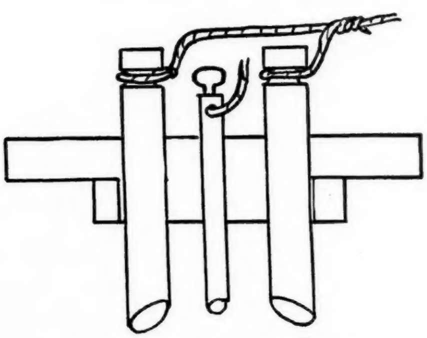
For the Instruction and Information of Younger Readers

A BICROMATE BATTERY

The type of battery most suitable for running motors or other closed circuit work, and at the same time easily made from inexpensive materials is that known as the Bichromate Battery. Three cells of this kind of battery will furnish sufficient current to run an electric railway train of several cars. The materials required for making one cell are, one jar, one electric arc light carbon (unplated), one Leclanche battery zinc, two fluid oz. sulphuric acid, two oz. pulverized bichromate of potash; two glass rods or strips of glass are also needed for stiring the liquids.

For the jar may be used one quart glass preserving jar or jam jar. Cut out a piece of wood 2″ wide and 1″ longer than the outside diameter of the top of jar. Make saw cuts on the under side of this piece of wood,





equal distance from each end, 1-4″ deep and other cuts lengthwise from the ends as shown in Fig. 1. This forms shoulders for holding the wooden piece in place on the jar.

Bore two holes *A*, 5-8″ diamenter and 1″ apart to receive the carbons, and another hole *B*, for the zinc. As zincs vary slightly in diameter, the size of hole *B*, should be slightly larger than the zincs used. The arc light carbon is usually 12″ long. This is cut with a hack-saw into two pieces, and a small groove filed around one end of each piece for attaching the wire. A short length of No. 18 bell wire is then firmly attached to these grooves by a tightly twisted loop. It adds to the efficency if these wires are soldered to the carbons. The wires from the two carbons are connected.

The carbons and zinc rods are then placed in the holes in the wooden cross piece, after wrapping a few turns of waxed paper around them where they come in contact with the wood. The rods should not touch each other at any place.

Fill the jar two thirds full of water and very slowly pour in one fifth the volume of sulphric acid as there is water. Handling the acid very carefully as it will badly burn the flesh or clothing if spilled thereon. *Never pour water into the acid.* Stir the water with a glass rod while pouring in the acid. When this solution has cooled, add as much bichromate of potash as the solution will dissolve, stiring constantly. The carbon and zinc can now be placed in the jar and the battery is ready to use. The zincs should be taken from the battery when through using as the consumption of zinc continues while the zinc remains in the solution whether a current is flowing or not. In time the solution will have to be replaced with a freshly made one.

A SMALL WORKSHOP

What live boy does not want a work-shop and play house. Usually he wants it sufficiently so that a structure more or less crude is created in the back yard out of odd pieces of boards and boxes. To build a better one out of stock from a lumber mill means an expense greater than many boys feel like putting out, so this description of how to build a good, servicable house at small cost will undoubtedly be of interest to many readers of this magazine.

The boards for the house are the important item in the matter of costs. Now every dry goods store receives during the year many packing cases of extra large size. On account of the size, these cases are not as salable as the smaller cases, but they are all the better for our purpose. The writer recently purchased eight large cases, each of them having over 80 square feet of matched pine, at 25 cents each. In this way about $20 worth of boards was obtained for $2. Many such stores would be very glad to give such cases in exchange for errand work on Saturdays or after school hours so that, in this way if a boy wanted to, he could get his boxes at no expense.

Six large cases will make a house 9′ long, 7′ wide, 6′ high at the sides and a 2′ rise to the roof. Eight cases will make one 10′ long, 8′ wide and 6′ high, with a rise to roof. In addition to the lumber in the boxes some 3″ x 4″ timber will be needed for the floor frame, but 3″ x 6″ would be a better size to use if the larger house is built. Visit the carpenters and builders in your neighborhood and see if some of them have not got some timbers of this size which have been used for stagings, and which they will sell you at a low price, only be sure it is a low price by first getting quotations at some lumber yard. Some short lengths of timber for foundation posts can often be secured for the asking at some new house in process of building, if you mention why they are wanted. It will also be necessary to buy one bundle of planed "furring" which comes ten strips to the bundle, 12′ to 14′ long and 1″ x 3″ at a cost of about 50 or 60 cents. With a supply of spikes and nails, building may begin.

The boxes are carefully taken apart, excepting the ends which can probably be used as they are for the flooring. These ends are carefully inspected and arranged so they will fit each other as nearly as possible to the sizes of the floor, say 6′ 6″ x 8′ 6″. We can then cut the timbers for the floor so that when put together they will make a frame 7′ x 9′ Posts for foundations are then placed at each corner and half way between. Cross timbers are put in so the centres will be under the edges of the box ends, and additional foundation posts under the larger cross timbers will make the floor firmer. When the timbers are all in place, the box ends are all spiked down, the joints between them being fitted to make the cracks as small as possible and care taken to match them together in such a way that one section will not be higher than another.

Before proceeding further, it will be well to measure the lengths of the boards to be used for the siding, and plan out the framing to be made of the "furring". Uprights are necessary in each corner and at the door and windows. Horizontal pieces are placed so that the ends of boards will centre on them, after sawing off one end of each board to avoid the nail holes and so get a better appearance. The boards are placed perpendicular, with broken joints, the same as clapboards are put on. To do this, it will be necessary to match up the widths of the boards to get them together in good shape.

Some of the boards will have no tonguing or grooving, and these should be used at the corners and around windows and the doors. Single sash windows can be used, and hung with hinges at the top to open outward, so that in rainy weather the window can be opened and no water come in.

The roof can be shingled or covered with roofing paper and tar paint, the latter being much the cheapest, but not looking as well. Sheathing paper can also be put between the framing and boards, giving the inside a more attractive look. If the house is to be used as a work-shop, a small four light double window on one of the longer sides will be desirable, affording an abundance of light.

A cheap pine door can be purchased at little more than the cost of wood for making one; a door frame being made of strips 4″ wide. A house, as here described can be built at a cost of $8.00 to $10.00 and look nearly as well and be quite as useful as one costing several times this amount.

HANDY RECEIPTS

Shrinkage of Castings. — In making patterns for iron castings, allowance has to be made for shrinkage of the metal in cooling. While different sizes and shapes shrink differently, the following are given as a standard and are in general use by pattern makers: For loam castings, 1-12 inch per foot; green or dry sand, 1-20 inch; brass or copper, 3-16 inch; bismuth, 5-32 inch; tin 1-4 inch; zinc, 5-16 inch; lead, 5-16 inch.

To Write on Tin. — Rub the surface with an ordinary pencil eraser and write over this with pen and ink.

Indoor Whitewash. — A very good whitewash for indoor use is made with two pounds of paris whiting and 1 ounce of white glue, dissolved in warm water. Mix the whiting with warm water, stir in the dissolved glue and thin with warm water.

To Stop Creeping in a Battery. — There is a tendency for the fluids used in a battery to "creep," and this is often quite objectionable. A very good pomade for this purpose is made as follows: Paraffine wax, 2 parts: Vaseline, 1 part. Melt together and rub around the edge of the jar.

Etching on Steel. — This has to be done by first coating the surface of the steel with a preparation to protect it from the action of the acid. Two methods will be given. First: melt over a slow fire black pitch, white wax, Burgundy pitch, asphaltum and gum mastic. Second: Yellow bee's wax dissolved in turpentine and continuously decanted until no sediment remains. To 6 parts of this add 1 part Japan varnish. Either of these make a good coating for etching. The surface of the steel should be thoroughly coated on all sides and on the edges with this. The figures or design to be etched is then drawn on this with a small, pointed tool which will remove the coating where the etching solution is to act. Place the piece of steel in a bath made as follows: 2 ounces copper sulphate, 1-2 ounce alum, 1-2 ounce salt, 1-2 pint vinegar and 40 drops nitric acid. Rock the tray slowly until the etching is sufficiently deep and then rinse thoroughly with water and remove the coating.

To Separate Postage Stamps. — When stamps adhere to each other they can be easily separated by placing them between two pieces of moist blotting paper and allowing them to remain a few moments when they can be separated without injuy.

CORRESPONDENCE.

Our readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of Amateur Work, 63 Kilby Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if direct answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

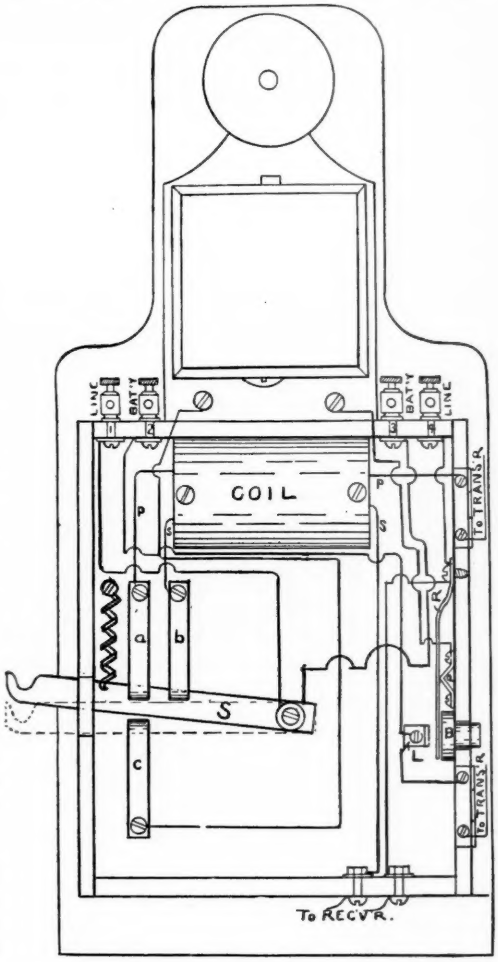
(No. 39.) Toronto, Ont., Mar. 1, 1903.

During the course of construction of 'phone described in your October, November, and December issues, I found what appears to be an error in the wiring in connection with switch. I enclose a sketch of wiring of instruments which I have now in operation and which work well.

A few little improvements I made may be of use to my brother amateurs.

In the first place, the box containing switch, coil, etc., should be made of 3-8" stuff, as cigar box wood will not stand wear and tear very long. The switch hook will work better if spring is placed nearer hook as in sketch, as it will thus get more leverage. The strength of this spring is largely a matter for experiment, but unless receiver is very heavy it should be made of fine brass or piano wire, (latter is best). I wound my springs on a mandrel 3-16" diameter in a lathe, letting wire pass between the jaws of wooden clamps to give even tension and a close coil.

A soldering iron was found more convenient in making joints than blow torch in such confined space, and electricians soldering paste is cleaner and better than powdered resin. The box enclosing spool of receiver I turned out of a piece of hardwood, this being neater and more durable than an ointment box. My permanent magnet is not as heavy as the one described, being 6" x 3-4" x 1-8". I drilled it in two places putting two wooden pieces, one on each side, making a convenient handle. These extend about 2 inches below magnet. Screws were passed through wood and the drilled holes to hold all firm. The hook to hang receiver up by, I inserted in bottom of box that holds spool as it is more convenient to hang that end than to have to reverse it each time it is used. I also found it easier to turn the transmitter mouth piece out of wood and screw it on, than to use card-board, not to mention a better appearance. The transmitter itself I made separately, that is, it was made from a disk of wood 3" diameter, having a solid brass back, to which the back electrode was attached. The front electrode was recessed into face of disk and held in place by small metal clips, connections being taken from these and the brass back. Thus the whole thing, which is 1-2"



thick, was fastened inside door of box exactly back of mouth piece by brass clips, thus facilitating easy removal for repairs, etc. The solid brass back gives less vibration than a wooden one and results are better.

I used a circular disk of thin carbon for front electrode, instead of ferrotype plate and carbon, both front and back electrode may be had at any electrical shop for 25 cents, and I would suggest buying these instead of making them. These remarks are not intended as a criticism of Mr. Holland's 'phone, but are a few little changes which suggested themselves, and will add to its efficiency. A. H. W.

(No. 40.) ALBANY, N. Y., MAR. 3, 1903.

1. Will you kindly furnish me with the full address of the manufactures of the Weeden Model Steam Engines? 2. I have a small toy motor of the "Rex" type but it does not run. The insulation of the field and armature seems to be perfect, the segments (three in number), face each arm of the armature. Can you tell me what is the trouble?

1. The address of the Weeden Mfg. Co., is New Bedford, Mass. 2. The information you give regarding the motor is rather inadequate to determine the cause of the trouble. The following suggestions may enable you to locate it. Look over all connections carefully to see that they are correct; examine the armature to see that it has not been burned out by an excessive current, also see that the brushes bear lightly and correctly on the commutator. If you are then not able to locate the trouble, take the motor to an electrian of a lighting station and he will find it for you.

THE BOOK-SHELF

THE USE OF THE SLIDE RULE. F. A. HALSEY, D. VAN NOSTRAND CO., NEW YORK, 50 cents.

This volume is No. 114 of the Van Nostrand's Scientific Series. It presents in very convenient form, plain and comprehensive directions for the use of the slide rule, the most valuable mental labor-saver which the mathematician can possess, and which should be in more general use than it is.

The basis property of logarithms, upon which the slide rule is constructed, is briefly but adequately explained and the mechanical operations are then fully described, with illustrations which are true reproductions of the instrument, showing it properly set for solving the various problems. With this book as a guide, the successful use of the rule should be only a matter of care and practice.

PERSPECTIVE DRAWING PREPARED BY W. H. LAWRENCE, S. B., AMERICAN SCHOOL OF CORRESPONDENCE, CHICAGO, ILL.

The very thorough and plainly expressed manner in which the writer has presented the subject, deserves the warmest commendation. The student who will make a careful study of the several chapters cannot fail to have derived much benefit therefrom. Numerous well selected illustrations, nine of which are large plates, fittingly supplement the text. As a book of instruction for correspondence instruction, it must serve the purpose admirably. If all the instruction given by this school is upon the same comprehensive basis, its work is indeed excellent.

A. B. C. OF THE STEAM ENGINE. J. P. LISK, M. E., SPON & CHAMBERLAIN, NEW YORK. 50 cents.

The young man interested in acquiring a general knowledge of the parts of the steam engine will find his book of great value. Six large plates show the different parts, 76 in number, of a single cylinder, high speed, horizontal steam engine, the parts being indicated by reference, in both text and drawings. The functions of the several parts are described, and much additional information is also included, making it an excellent book for the beginner.

TRADE NOTES

Many of our readers will be interested in the advertisement of Swett & Lewis Co., 18 Boylston St., Boston, which appears in another column, announcing that orders for parts of Wimshurst machines, batteries, etc., will be filled by this firm. This firm are well known manufacturers of electrical machines, and the goods they advertise are of the best.

The attention of those who are making any pieces of furniture described in this magazine, is called to the advertisement of F. L. Goldsmith, 19 Chardon St., Boston. This firm is making a specialty of getting out stock to special design. Estimates will be cheerfully furnished for the wood necessary to make any article the amateur is desirous of making.

The Card System is now in such universal use as to require no mention of its many great advantages, but many users of it have experienced delay in getting orders promptly filled, especially if other than a stock design is wanted. J. R. Rhodes, 143 Congress St., Boston, is equipped with excellent facilities for quickly filling all orders, and users of card systems will find it to their advantage to call or correspond with him.

This is the season for painting, inside or outside, and good paint is necessary it the work is to be satisfactory. The high reputation of the Carpenter-Morton Co., is a guarantee that paint supplies obtained of them will be as represented, and entirely satisfactory to the user.

The "Ever Ready" portable electric hand lamp, as well as the many other useful and practical novelties manufactured by the American Electric Novelty & Mfg. Co., are well liked by those who are familiar with them. Of uniformly good quality, they are sure to please. A catalog will be sent upon request from the New England Office, 35 Kingston St., Boston.

Wood-workers in manual training schools will find very convenient the small packages of stains, varnishes and enamels, advertised in another column by Wadsworth, Howland & Co., 84 Washington St. and 16 Clarendon St., Boston. The prices named include postage, so that orders can be sent and filled by mail, which readers at a distance will greatly appreciate.

Catalog F, just issued by the Sawyer Tool Mfg. Co., Fitchburg, Mass., contains several new tools of interest to mechanics. The new surface gauge, mentioned in their advertisement, embodies all the essential qualities a mechanic can desire, having a very wide scope of usefullness.